ROMANIA'S ENERGY POTENTIAL OF RENEWABLE ENERGIES IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT

Maghear Diana
University of Oradea Faculty of Economics

The concept of "sustainable development" and the necessity for its realization has gone a long way in order to be unanimously accepted. Over time many authors have written about the problem regarding resources depletion, about the effects of pollution and their economic, ecological and social aspects of it. From the observation of the pollution phenomenon and its implications and until this problem has been acknowledged and accepted by a large number of people this problem has been extensively described by various authors be they economists, ecologists, biologists or psychologists and discussed at multiple conferences conducted in order to find a solution to this problem.
În ultimul secol, folosirea combustibilor fosili (cărbuni, gaz, petrol) a avut efecte dezastruoase, catastrofale asupra mediului înconjurător, mai mari decât orice activitate umană din istorie. In the last century, the use of fossil fuels (coal, gas, oil) has had disastrous effects, catastrophic even on the environment, greater than any human activity in history. Dintre aceste efecte putem enumera: încălzirea globală, apariţia ploilor acide, subţierea stratului de ozon, etc. Among these effects we can enumerate: global warming, the emergence of acid rains, thinning of the ozone layer, etc. Prin urmare, utilizarea unor resurse alternative de energie devine iminentă pentru lumea de azi.InInIiU=In consequence, the use of alternative energy resources becomes imminent for the today world. Printre aceste resurse se numără soarele, vântul, apa geotermală, biomasa, apa, etc, care au capacitatea de a genera energie alternativă şi anume: energia solară, energia eoliană, hidroenergia, energia valurilor, energia geotermală, bioenergia (biocombustibilii), biodieselul, etc. Among these resources we can include the sun, the wind, geothermal water, biomass, water, etc., which have the capacity to generate alternative energy namely solar energy, wind energy, hydro energy, wave energy, geothermal energy, bioenergy (biofuels), biodiesel, etc.care au menirea de a reduce poluarea termică, radioactivă, chimică oriunde pe glob. that have the as purpose the reduction of the thermal, radioactive and chemical pollution anywhere on the globe.
Sursele de energie regenerabile sunt în mare măsură indigene, nu se bazează pe disponibilitatea în viitor a surselor convenţionale de energie, iar natural or predominat descentralizată face ca economia respectivă să fie mai puţin vulnerabilă în faţa alimentării cu energii volatile.Renewable energy sources are largely indigenous; they are not based on the future availability of conventional sources of energy, and natural or predominantly decentralized makes that the respective economy to be less vulnerable in front of the supply with volatile energy. Prin urmare, ele constituie un element cheie al unui viitor energetic durabil. Therefore, they constitute a key element of a sustainable energy future.
This paper is meant to highlight the need for achieving a sustainable development both in terms of the problem that humanity faces which threatens the entire ecosystem and namely the environmental pollution as well as the depletion of the conventional resources that are highly polluting, highlighting the energy potential that renewable energy resources Romania has. This issue will be extensively discussed in the thesis entitled "The necessity and importance of sustainable development of Romania. Case study on the use of renewable energies for heating the population in the western part of Romania" which I intend to realize and support at The West University of Timisoara, Faculty of Economics and Business Administration, under the guidance of Professor Doctor Laura Cismaş.
Keywords: Sustainable development, solar energy, geothermal energy, biomass, wind energy

JEL: O13, Q01, Q27

Energy production technologies that use renewable resources are in different stages of development and marketing. The energies produced from renewable sources in 1998, the U.S., 55% came from hydro sources, 38% from biomass, including municipal solid waste, 5% from the geothermal source, 1% from solar power, 0.5% from wind power. Renewable energy resources are available all over the globe and can be found in abundance. Renewable energy technologies generate relatively little wastes or pollutants that contribute to acid rains, urban smog, or to could cause health problems and do not generate additional costs for environmental remediation or for waste disposal. Energy systems' owners of based on renewable resources should not be concerned about the potential global climate changes caused by excessive CO2 and other polluting gases. Solar energy systems, aeolians and geothermal energy (most of them) do not generate CO2 in the atmosphere, but the biomass absorbs CO 2 when it regenerates and that is why the entire generation, use and regeneration process of biomass leads to global emissions of CO 2 close zero. At present there are already several regenerative energy technologies, alternatives to burning fossil fuels for energy production, namely hydropower, aeolian, nuclear, geothermal, solar energy conversion technology, biomass, etc. (Bucharest: Alpopi, Florescu, 2009)

Solar Energy

The sun is one of billions of stars, but also the energy source of all living beings on the entire Earth. The solar energy that reaches the Earth in 40 minutes would be enough energy to meet the need for an entire year of all mankind. The man uses to such an extent fossil fuel based material - oil and coal - that the reserves will be exhausted in the second part of the next century. In the past, there was the belief that nuclear power is an alternative solution, but its degree of nuisance value is demonstrated by the Chernobyl catastrophe of 1986 and again in Japan. It was demonstrated that the energy sources that could replace fossil fuels, solar energy offers the greatest safety and accuracy.

Anatoine Becquel discovered the possibility of generating an electric current under the action of light in 1893. Since then, the electricity produced by the photovoltaic technology was asserted from an economically point of view and not only.

Worldwide sales of photovoltaic systems reached in 1998 at 150 MW, after a decade in which they have increased by 15-20% per year. (Bucharest: Motoc, 2009)

Arriving at a sales turnover of approximately 1 billion dollars, the photovoltaic industry has set new standards, has entered new markets and has demonstrated its economic viability.

It is estimated that the transition period of energetics will end around the years 2100-2200, when it will reach a stage of stable energy sector, by making unlimited energy source.

Solar energy represents the most impressive and reliable source of energy. Within 20 minutes, the sun provides the annual equivalent of energy consumption of mankind. On the Romanian territory, on a horizontal surface of 1 m², we can annually capture a lot of energy every between 900 and 1450 kWh dependent of course on the season. The average daily radiation can be 5 times more intense in summer time than in winter. But even in winter time, during a sunny day, we can capture 4-5 kWh/m²/day, solar radiation captured regardless of the surrounding temperature. Solar panels and system components from the Viessmann offer allow the exploitation of the solar power in various fields of applications: the preparing of the domestic hot water, pool water heating, heat input for heating buildings, heating for technology processes. The premises for using solar energy for preparing the domestic hot water are particularly advantageous due to the continuously changing evolution of the requirement during a calendar year. The overlap of energy necessary for preparing SCR (the so called solar coverage rate) with the available solar energy is higher than in the case for heating buildings. A properly sized system can cover 50-65% of the annual necessary of SCR, in summer the coverage is most often 100%.

Modern solar thermal systems can be incorporated without difficulties in the building facilities and have an estimated lifespan of over 20 years, making it an ideal complement to the modern heating technology. Starting from the data available was made a chart with the distribution of solar radiation on the territory of Romania. The chart contains the average annual flow distribution of the solar energy incidents on the horizontal surface of Romania.

Figure 1. Analysis of the solar radiation in Romania

	Temperatura aerului	Umiditate relativă	Radiație solară zilnică - orizontal	Presiunea atmosferică	Viteza vântului	Temperatura solului	Grade -zile lunare pt.încălzire	Grade -zile pentru răcire
	°C	%	kWh/m²/zi	kPa	m/s	°C	°C-z	°C-z
Ian	-0,8	89,0%	1,25	99,3	2,8	-2,3	583	0
Feb	0,5	83,2%	2,12	99,1	2,9	-1,0	490	0
Mar	5,3	76,1%	3,17	99,0	3,1	4,4	394	0
Apr	11,0	72,8%	4,37	98,6	3,2	11,7	210	30
Mai	16,3	72,6%	5,35	98,7	2,7	17,9	53	195
Iun	18,7	75,1%	5,67	98,7	2,4	21,2	0	261
Iulie	21,1	72,0%	5,66	98,7	2,2	23,9	0	344
Aug	20,8	72,6%	5,05	98,8	2,0	23,8	0	335
Sept	16,2	77,6%	3,69	98,9	2,3	18,3	54	186
Oct	11,2	80,0%	2,35	99,2	2,2	11,7	211	37
Nov	4,2	85,5%	1,33	99,1	2,4	4,1	414	0
Dec	0,1	89,2%	0,98	99,3	2,7	-1,0	555	0
Anual	10,4	78,8%	3,42	99,0	2,6	11,1	2.963	1.388
Sursă	Sol	Sol	NASA	NASA	Sol	NASA	Sol	Sol
			Măsurat la	m	10	0		

Source: Data calculated by the author based on the program RetSreen

Regarding solar radiation, monthly deviation values on the territory of Romania reaches maximum values in June (1.49 kWh / m2/day) and minimum values in February (0.34 kWh / m2/day).

Thus, solar radiation for Romania represents approximately 330 million GWh per year (namely, the theoretical potential of solar energy). The technical surface that can be arranged is of approximately 30% of the available constructible area. So, the available constructible surface in Romania is of about 630 km2, of which solar collectors could be installed on an area of 210 km2. Each square meter of collector from Romania produces approximately 440 kWh of electricity or 1440 MJ of thermal energy per year. In order to replace the total amount of solar thermal energy required for heating in Romania (62,000 MJ) with solar thermal energy it is necessary a surface of 43km2 of collectors. This represents 20% of the total usable area of 210 km2. (Bucharest: Afloare, 2009)

At present in Romania there are 100.000m2 (0.1 km2) of collectors installed, which represents 0.045% of the useable area.

Wind energy

Aeolian energy is a renewable source of energy generated by wind power. At the end of 2006, the global capacity of wind generators was of 73,904 MW, these producing a little more than 1 percent of the world electricity needs. Although considered a relatively minor source of electricity for most countries, aeolian energy production has increased almost five times between 1999 and 2006, reaching a point that, in some countries, the share of wind energy in the total of energy consumption is significant: Denmark (23%), Spain (8%), Germany (6%). (Bucharest: Dobrescu, 2009)

Wind energy is widely used today, and new wind turbines are being built all over the world, aeolian energy is the energy source with the fastest growing rate in recent years. Most turbines generate more than 25% of the time, this percentage increasing in winter, when winds are

stronger. It is believed that the global technical potential of aeolian energy can provide five times more energy than is consumed now. This level of exploitation would require 12.7% of Earth's surface (excluding oceans) to be covered by parks of turbines, assuming the fact that the land would be covered with 6 large wind turbines per square kilometer. These numbers do not take into account the improving turbine efficiency and that of the technical solutions used. (Bucharest: Poenaru, 2009)

It was considered necessary and appropriate the approach of some activities addressing the revaluation of Romania's wind potential, by using appropriate means and adequate tools (measuring devices, appropriate software, etc.) starting from the wind data measured at 22 stations belonging to the NMA.

The distribution on the territory of Romania of the average wind speed reveals that the main area with wind energy potential is that of mountain peaks where the wind speed can exceed 8 m/s.

The second area with aeolian energy potential that can be used in a cost-effectively manner is the Black Sea seaside, the Danube Delta and the north part of Dobrogea where the annual average wind speed is around 6 m/s. Unlike other areas of aeolian energy potential exploitation in the area is favored by less wind turbulence.

The third area with a considerable potential is the Bârlad Plateau where the average wind speed is about 4-5 m/s. Favorable wind speeds are also reported in other smaller areas in the western part of the country, in Banat and the western slopes of the Western Hills. In the capitalization strategy of the renewable energy sources, the wind potential is of 14,000 MW (installed capacity), which can provide a quantity of energy of about 23.000 GWh / year. These values represent an estimate of the theoretic potential and must be nuanced depending on technical and economic possibilities of exploitation.

Geothermal energy

The direct use of geothermal energy is one of the oldest, most versatile and also the most common forms of using energy. (Writings reveal that the use of geothermal energy dates back over 2000 years).

At present, studies of the domain show that Earth's geothermal potential is of approximately 13,000 ZJ per year, of which approximately 2000 ZJ could be used to produce electricity, with the help of geothermal power plants. If we could get to use only 0.25% of this potential, we wouldn’t need coal, plutonium, oil and gas for generating electricity. Currently, we use only 1% of the world's electricity necessary which is covered by geothermal sources, so use 0.0025% of the full potential. (www.energeia.ro)

The usage of the extracted geothermal energy used for heating is of 37%, 30% for agriculture (greenhouses), 23% in industrial processes, 7% for other purposes. From a number of the 14 geothermal wells drilled between 1995- 2000 to depths of 1500-3000 m, only two wells were unproductive, recording an 86% rate of success.

Five wells that are available have temperatures above 100° C. The national exploitable reserve is about 167 thousand toes / year low enthalpy resources, of which currently builds about 30.000 toes/ per year. The total installed capacity in Romania in the west and northwest part is 320 MWh (for a reference temperature of 300° C).

Biomass

Another way of producing electricity and heating domestic water is to use biomass. Biomass is a scientific term for living materials (any organic material derived from plants as a result of the photosynthesis process). The same term is used for products derived from living organisms (wood, harvested plants, parts of plants and other plant residues) and aquatic plants and animal wastes. According to the Directive RER-electricity, "biomass” is the biodegradable fraction of products, wastes and residues from agriculture (including animal and vegetable substances), forestry and woodworking, as well as biodegradable fractions of industrial and municipal wastes.

Romania has a high biomass energy potential, which represents almost 19% of total primary resources energy consumption in 2000. Romania's potential in the production of green energy is of 65% biomass, 17% aeolian energy, 12% solar energy, 4% micro hydro plants and 2% voltaic plus geothermal 12.
Romania has important renewable resources distributed in different parts of the country but they are not exploited to their full capacity, with the exception of the hydropower resources.
On the other hand the policy regarding energy is mainly a national issue, because energy is considered a strategic asset, therefore the investments in this sector are much needed. In addition the EU's main instrument in fighting the weather changes is constituted by the climate policy, because this sector produces 80% of the total emissions of the greenhouse gases.
To these it can be added that the Romanian energy sector the majority of the existing facilities are outdated. Given this situation the investments in this large area were built around the 80's and the maximum duration of operation guaranteed of the electric power stations and the thermal ones is of 30 years. If we add the technical progress and the European targets for reducing pollution, we strongly believe that the use of renewable resources represent a necessity and at the same time a solution for many national and European or even global problems.

Bibliography

1. Afloare Adriana Ioana, *Virtutile energiei solare*, Editura Sigma, 2009,
2. Bălan Emilia*, Bioenergia- Sursă importantă de energie a Uniunii Europene*, Editura Sigma 2009
3. Brown, L., Plan B 2.0 – *Rescuing a planet under stress and a civilization in trouble*, Editura WW Norton & Company, New York, 2006
4. Dobrescu Emilian (coordonator), *Energiile regenerabile. Eficienţa economică, socială şi ecologică*, Editura Sigma 2009
5. Middleton, N., O'Keefe, P., *Redefining sustainable development*, Editura Pluto, Londra, 2001
6. Poenaru Laviniu Sergiu, *Energia eoliana*, Editura Sigma, 2009, pg. 213
7. Alpopi Cristina, Florescu Margareta, *Utilizarea surselor de energie regenerabile*, disponibil on-line pe site-ul http://www.ramp.ase.ro/_data/files/articole/6_04.pdf accesat în data de 10.01.2010
8. Motoc Claudia, Garip Marius, *Energia fotovoltaică*, disponibil on-line pe site-ul http://www.iem.pub.ro/ro/informatii/Conversia_Energiei_2000/2000/lucrarea_7/conversia_energiei.htm accesat în data de 03.02.2011
9. Teza de doctorat: *Aspecte privind valorificarea energiei solare şi a enegiei geotermale*. Doctorand: Onica-Chipea Florin, coordinator ştiinţific: Maghiar Teodor, disponibil on-line pe site-ul
http://www.uoradea.ro/attachment/791672704232e82e41d0a31a6bc16159/e13b10924f6b8cc24dab4668f25bfc79/Onica_Chipea_Florin.pdf accesat în data de 03.02.2010
10. Studiu privind evaluarea potenţialului energetic actual al surselor regenerabile de energie în România (solar, vânt, biomasă, microhidro, geotermie), identificarea celor mai bune locaţii pentru dezvoltarea investiţiilor în producerea de energie electrică neconvenţională disponibil on-line pe site-ul http://www.minind.ro/domenii_sectoare/energie/studii/potential_energetic.pdf accesat la data de 25.04.2010
11. http://www.energeia.ro/energie-geotermala/potentialul-geotermal-al-terrei-de-4000-de-ori-necesarul energetic-global-549/. accesat în data de 23.02.2011